CLIDICUS ABBOTENSIS O'KEEFE, A NEW SPECIES OF SCYDMAENIDAE (COLEOPTERA: STAPHYLINOIDEA) FROM AUSTRALIA WITH DESCRIPTION OF THE LARVA

SEAN T. O'KEEFE AND G.B. MONTEITH

O'Keefe, S.T. & Monteith, G.B. 2000 12 31: *Clidicus abbotensis* O'Keefe, a new species of Scydmaenidae (Coleoptera: Staphylinoidea) from Australia with description of the larva. *Memoirs of the Queensland Museum* **46**(1): 211-223. Brisbane. ISSN 0079-8835.

Clidicus abbotensis O'Keefe sp. nov. (Coleoptera: Scydmaenidae) (type locality: Mt Abbot, Queensland, Australia) is described from both adults and larvae. Mouthparts of adults and larvae, male and female genitalia, and general body morphology of adults and larvae are described and illustrated. The known distribution of *Clidicus* Laporte is extended over 3,500km from Java and Borneo to northeastern Australia. A catalogue and key to all *Clidicus* species is included. ❐ *Coleoptera, Scydmaenidae, Clidicus, Australia, taxonomy, biogeography, catalogue, larval morphology.*

Sean T. O'Keefe (e-mail: sokeefe@ tamu.edu), Department of Entomology, Texas A & M University, College Station, Texas 77843 U.S.A.; G.B. Monteith, Queensland Museum, PO Box 3300, South Brisbane 4101, Australia; *received 18 June 1999.*

The Indomalayan genus *Clidicus* Laporte has the largest Scydmaenidae in the world, with species up to 10mm (*C. grandis* Laporte) in length. This is an extraordinary size considering that the body length for nearly all other genera is under 2mm. To date, the genus includes 11 described recent species, and one from Baltic amber. With the possible exception of *Leptomastax* Pirazzoli, *Clidicus* has received more published attention than any other genus of Scydmaenidae. However, of the numerous articles on the genus, only Wasmann (1896) intended his as a thorough revision, briefly reviewing the literature and recognising only three species: *C. formicarius* Pascoe, *C. grandis* and *C. taphrocephalus* Gestro. A fourth species, *C. monstrosus* (Walker), was not dealt with by Wasmann, but was included in the world catalogue of Scydmaenidae (Csiki, 1919). Since Wasmann's revision eight additional species have been described. *Clidicus balticus* was described by Schaufuss (1896) from Baltic amber and is of considerable interest because of its implications for scydmaenid biogeography. The remaining seven species were described by Pic (1928), Lhoste (1937a, 1937b, 1939) and Besuchet (1971). Pic (1928) published a short description for *C. laticeps* from Indonesia. Lhoste (1937a) described the first *Clidicus* from the Asiatic mainland (*C. tonkinensis*, Vietnam) and redescribed it as a new species in his 1937b paper. This latter paper is a brief review of *Clidicus* with a key to the six species known then. It also included a habitus illustration for *Clidicus* and figures of the male aedeagi for *C. grandis* and *C. tonkinensis*. Later, Lhoste (1939) described *C. mysorensis* from India and *C. termitophilus* from Borneo and included figures of the male aedeagi for both. Besuchet (1971) revised the Sri Lankan species of *Clidicus*. He examined the type material of *C. monstrosus* and described three new species: *C. mussardi* Besuchet, *C. loebli* Besuchet and *C. quadricollis* Besuchet. Besuchet illustrated the aedaegus of *C. mussardi*, the ovipositor of *C. loebli* and *C. mussardi*, and the spermatheca of all four species.

In this paper we describe a new species from an isolated mountain top in northeastern Australia. It includes the first description of a larva in the Clidicini and the first figures and descriptions of mouthparts and general body morphology. We discusses the disjunct distribution of this species from other *Clidicus*. Authorship of the new species is attributed to S.T. O'Keefe.

DISCOVERY OF *CLIDICUS* IN AUSTRALIA

Mount Abbot is an isolated and inaccessible mountain which rises abruptly to 1,056m from a flat coastal plain about 60km inland from the coastal town of Bowen at 20°05'S in tropical north Queensland (Fig. 5C). Geologically it is a granitic batholith exposed by weathering (Paine & Cameron, 1972) and has extensive areas of exposed rocky slopes and domes giving it a biologically depauperate appearance when viewed from a distance.

Although Mt Abbot lies within three large private grazing properties whose joint boundaries

intersect near its summit, it is not used for grazing and has apparently never been climbed by its owners. Rough vehicle access to its base is possible at several points and from there the summit can be reached by a 5-6 hour walk. The first known biological observations of the upper parts of the mountain are as recent as 1992 when botanist A.R. Bean, of the Queensland Herbarium, surveyed the vegetation during 5 solo ascents, totalling 12 days. He reported a pristine wilderness with a diverse vascular flora of 493 species including 4 new species and numerous major range extensions and disjunctions (Bean, 1994). The flora included only 11 introduced weed species. Bean described 7 vegetation types of which 3 predominated above about 700m. These were montane heath on rock pavements where soils were thin, wet sclerophyll forest where soils were deep, and very limited occurrence of rainforest as narrow strips along some of the higher altitude gullies.

Subsequently, two Queensland Museum parties, including the junior author, made faunal collections in December 1996 (3 days) and April 1997 (4 days). They found an exciting relict native fauna, and an apparent absence of feral animals (cattle, horses, goats, pigs, rabbits, cane toads), which detract from the wilderness values of many other mountain areas in north Queensland. The topography of Mt Abbot and collecting sites are shown in Fig. 5B.

During the December visit (dry season), two specimens of a large, ant-like, unrecognised beetle were taken on the underside of a piece of wood lying on the ground in fringing rainforest at 750m in the gully called 'Big Gully' by Bean. A third was taken by pyrethrum spraying of tree bases in a patch of *Livistona* palms and rainforest shrubs at 850m in the saddle immediately east of the summit. The specimens were found to belong to the family Scydmaenidae but were 4 times the length of any species previously known from Australia. On submission to the senior author they were identified as belonging to the genus *Clidicus*, being the first record of the Tribe Clidicini from east of Wallace's Line, and some 3,500km beyond its known range (Fig. 5A).

On return to Mt Abbot the following April (end of wet season), another search was made for the species. It was found to be common in the original gully, for which the more appropriate name of 'Scyd Gully' was proposed, and 108 specimens were taken in a few hours. Twenty-three specimens were also taken in the open wet sclerophyll vegetation, but only above about 950m altitude on the shoulder to the immediate west of the absolute summit and on the summit of the secondary summit knoll which is 500m east of the true summit. It was not detected during 3 days in similar habitat at the 800m camp 1.5km east of the summit, nor was it taken in heath vegetation. The species seems to be confined to an area of perhaps 1-2km^2 around the summit and extending slightly down the damper upper part of Scyd Gully. This may be controlled to some extent by the incidence of clouds which often enveloped the summit but not down to the altitude of the camp. Frequent summit cloud generates a specialised environment for insects on other north Queensland mountains (Monteith, 1985).

Clidicus abbotensis O'Keefe, sp. nov.
(Figs 1-4)

MATERIAL. Holotype. ♂, Qld, Mt Abbot (20°06'S, 147°45'E), RF Gully, 750m, 10.iv.1997, Monteith, Cook and Janetzki (Queensland Museum, Brisbane, QMT 62985). Paratypes (98). All Mt Abbot: 1 ♂ 2 ♀, summit area, 750-1000m, 8-10.xii.1996, G. Monteith, D.& I. Cook; 2 ♂ 2 ♀, RF Gully, 750m, 10.iv.1997, G. Monteith, pyrethrum [fogging of] trees, and rocks; 37 ♂ 30 ♀, same locality, Monteith, Cook, Janetzki; 6 ♂ 16 ♀, 800-1000m, 9-12.iv.1997, Monteith, Cook, Janetzki; 1 ♂ 1 ♀, summit shoulder, 1,000m, 11.iv.1997, Monteith, pyrethrum [fogging of] trees. Paratype adults deposited in California Academy of Sciences, San Francisco; Essig Museum of Entomology, Berkeley; Field Museum of Natural History, Chicago; Museum of Comparative Zoology, Harvard University, Cambridge; United States National Museum, Washington DC; Texas A & M University Collection, College Station, Texas; Australian National Insect Collection, Canberra; The Natural History Musem, London; Natural History Museum, Geneva; Queensland Museum, Brisbane, and S.T. O'Keefe collection. Larvae (7) are deposited in Queensland Museum, Field Museum, and S.T. O'Keefe collection.

DIAGNOSIS. *Clidicus* can be distinguished from other Scydmaenidae by large size (4-10mm) or by the combination of characters: antennomere 1 7-8 × as long as wide; vertex at least twice as wide as long, with shallow to deep posterior impression; and pronotum strongly convex, rounded, with posterior collar. *Clidicus abbotensis* differs from other species of *Clidicus* by its disjunct range in Queensland, Australia, instead of Indonesia to Sri Lanka or by the combination of characters: head dark brown, pronotum and elytra light reddish-brown, and antennae half as long as body (measured as antennomeres 11-XI).

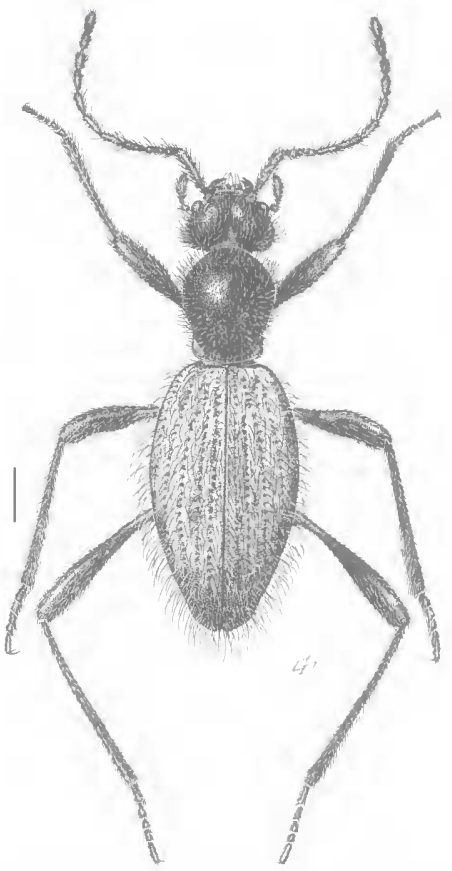

FIG. 1. *Clidicus abbotensis* O'Keefe, sp. nov., ♂, dorsal view. Scale bar = 1.00mm.

DESCRIPTION. ADULTS. Males 7.1-8.7mm long (mean = 7.9mm), females 6.7-7.6mm long (mean = 7.1mm); head dark brown, pronotum and elytra light reddish brown; setation moderately dense, strongly erect.

Head. (Fig. 3A-B) 1.3-1.7mm wide for males (mean = 1.6mm), 1.4-1.7mm wide for females (mean = 1.5mm); vertex 1.1-1.3mm long for males (mean = 1.2mm), 1.0-1.1mm long for females (mean = 1.1mm), distinctly wider than long; vertex 2.5 × as wide as long, with slight medial subtriangular depression at posterior margin; distinct ridge between clypeus and frons; frontoclypeal region flat, broad; occiput (oc) distinctly narrower than rest of head, sharply constricted from vertex, half as wide as head width at eyes, 1/4 length of entire head from frons to posterior of occiput; gular plate (gp – posterior and medial to posterior tentorial pits) fused to head, anterior margin fused with submentum (smt), posterior margin indistinct from occiput; posterior tentorial pits narrowly separated; submentum (smt) subtriangular, broad, narrowed posteriorly; hypostomal suture (hs) distinct; hypostomae (hy = crassa of Blackwelder, 1936) present, elongate, extended from submentum to clypeus; eyes relatively small, circular in outline, strongly convex, finely faceted, positioned just anterior to middle of head, at level of and posterior to antennal insertions; antennae (Fig. 3I) half body length (Figs 1, 2A), antennal insertions widely separated, exposed, medial to compound eyes; antennomere I elongate, 8 × as long as wide at widest point, apex emarginate; II twice as long as wide, slightly widened at distal end; III-VIII at least twice as long as wide, subcylindrical to slightly and gradually expanded at distal end, moderately covered with long, erect setae; III nearly twice as long as II; IV-VII subequal in size and shape, 2.5 × as long as wide; IX-XI each slightly wider than any of the preceding antennomeres, densely covered with both long and short erect setae.

Mouthparts. (Fig. 2B-E). Labrum (Fig. 2B) 1.5 × as wide as long, basal margin biemarginate, lateral margins convexly rounded, distal margin sinuate with deep median emargination, with 2 pairs of medial and 3 pairs of lateral setae; mandible (Fig. 2C) subtriangular, base broad, convex, apex recurved with 2 apical and 2 subapical teeth, prostheca (prth) with short setae from base of subapical tooth to near base of mandible, with 3 sensory setae; maxilla (Fig. 2D) with relatively small triangular stipes (st), subtriangular palpifer (plf), elongate galea (ga), and elongate lacinia (lc), palpus greatly enlarged, palpomere II elongate, slender, curved, with length 5 × width, palpomere III elongate, abruptly expanded at distal end, 4 × as wide at apex as at base, as long as palpomere II, paplomere IV subconical, half as long as palpomere III; labium (Fig. 2E) with mentum (mt) transverse, width 2.5 × length, rectangular, palpomere I moderate in size, subquadrate, with single elongate seta each on inner and outer apical margins, palpomere II elongate, length 3 × width, widest slightly before apex, with several moderate long and short setae along lateral margin and apex, palpomere III elongate, length 3-4 × width of base, nearly half length of II, apex pointed.

Prothorax. (Fig. 3C-D). Pronotum slightly longer than wide, 1.8-2.2mm long for males (mean = 2.0mm), 1.6-2.1mm long for females (mean =

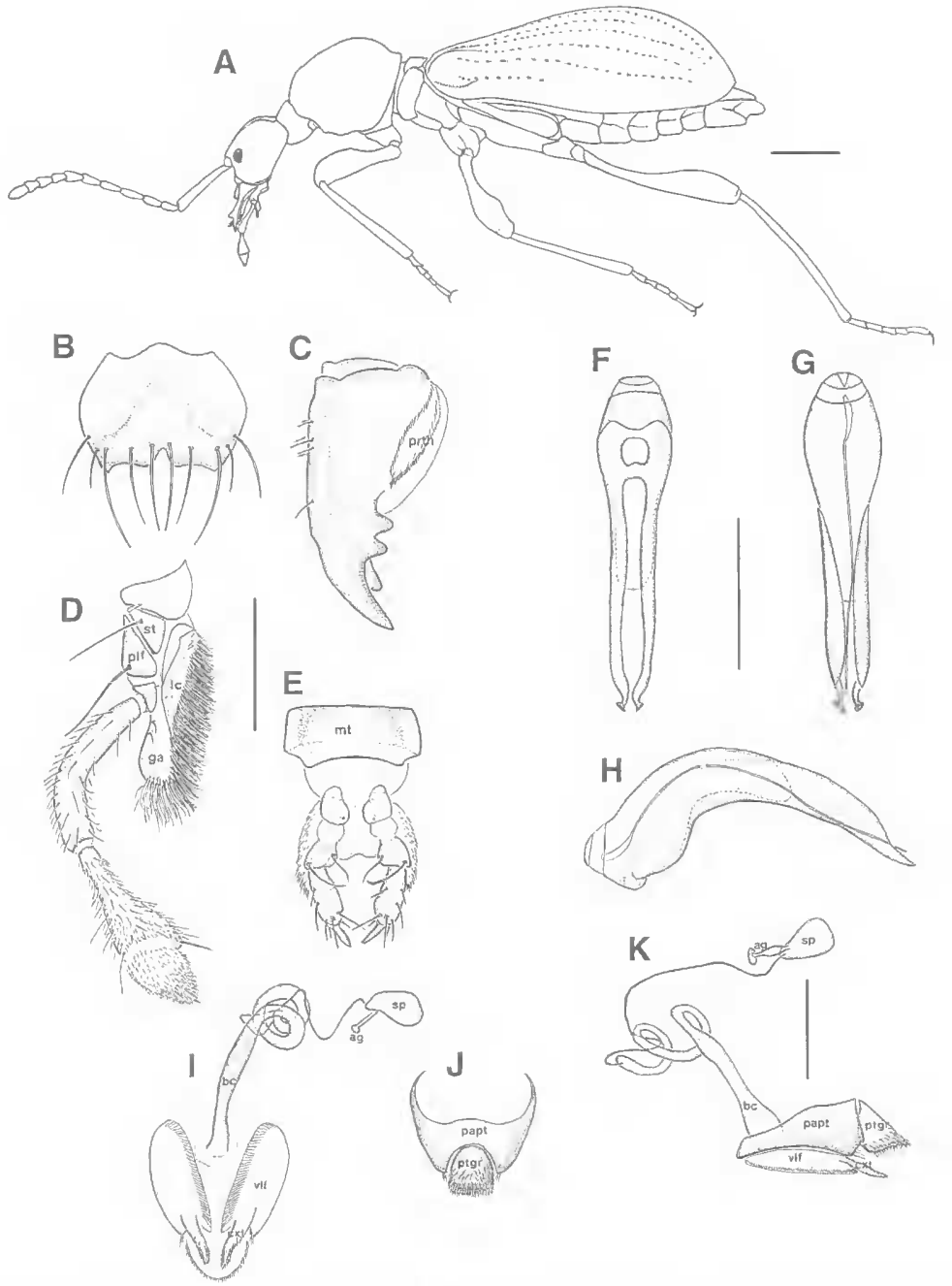

FIG. 2. *Clidicus abbotensis* O'Keefe. A, ♀, left lateral view; B, labrum, anterior view; C, right mandible, anterior view; D, right maxilla, anterior view; E, labium, ventral view; F, ♂ aedeagus, dorsal view; G, aedeagus, ventral view; H, aedeagus, left lateral view; I, ♀ ovipositor, dorsal view; J, ovipositor, ventral view; K, ovipositor, right lateral view. ag = accessory gland, bc = bursa copulatrix, cxt = coxite, ga = galea, lc = lacinia, mt = mentum, papt = paraproct, plf = palpifer, prth = prostheca, ptgr = proctiger, sp = spermatheca, st = stipes. Scale bars: A = 1mm, B-E and I-K = 0.50mm, F-H = 1.00mm

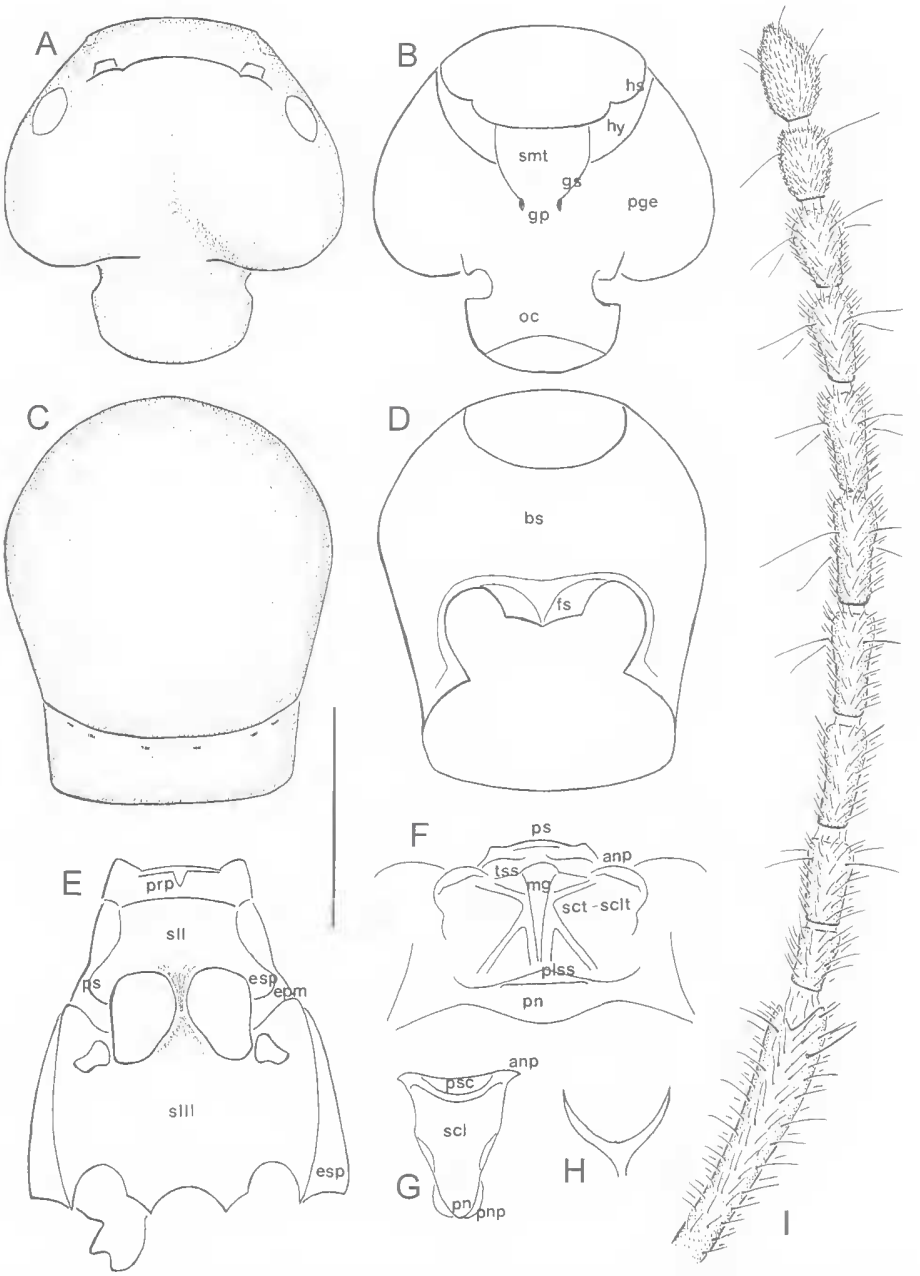

FIG. 3. *Clidicus abbotensis* O'Keefe. A, head, dorsal view; B, head, ventral view; C, pronotum, dorsal view; D, pronotum, ventral view; E, meso- and metasterna, ventral view; F, metanotum, dorsal view; G, mesonotum, dorsal view; H, metendosternite; I, right antenna, dorsal view. anp = anterior nodal process, bs = basisternum, epm = epimeron, esp = episternum, fs = furcasternum, gp = gular plate, gs = gular suture, hs = hypostomal suture, hy = hypostoma, mg = median groove, oc = occiput, pge = postgena, plss = posterolateral scutal suture, pn = postnotum, prp = prepectus, ps = prescutum, psc = prescutellum, s II = sternite II, s III = sternite III, scl = scutellum, sct-sclt = fused scutum-scutellum, smt = submentum, tss = transverse scutal suture. Scale bars: A-D and F-I = 1.00mm, E =1.50mm.

1.8mm), 1.4-1.8mm wide for males (mean = 1.6mm), 1.4-1.6mm wide for females (mean = 1.5mm); lateral margins distinctly rounded dorsoventrally as well as anteroposteriorly, widest at middle, anterior angles distinctly rounded, posterior angles tapered; posterior sixth sharply demarcated by transverse groove with 6 faint pits in a transverse row; basisternum + pre-episternum (bs) relatively long, one-third prothoracic length; tergopleural sutures lacking; furcasternum (fs) 3 × as broad as long, raised medially, anterior margin straight, posterior margin angled posteriorly at midline; procoxal cavities relatively small, widely separated by twice their length, evenly rounded.

Mesothorax. (Fig. 3E,G). Mesonotum (Fig. 3G) composed of prescutum (psc), scutellum (scl), postnotum (pn); prescutum transverse, narrow, convexly expanded posteriorly at middle, lateral margins terminate at anterior notal wing process (anp); anterior notal wing process angulate, slightly extended beyond prescutum; scutellum visible, large, twice as long as wide, sub-triangular, lateral margins sharply taper posteriorly, anterior margin concave; postnotum barely visible beneath and expanded beyond scutellum, lateral margins concave, posterior margin lobed medially; posterior notal wing process (pnp) apparently reduced or absent. Mesosternum (Fig. 3E) composed of prepectus (prp), episternum (esp), epimeron (epm), basisternum (s.II); prepectus distinct, transverse, flat, marked from sternum by faint suture and narrow transverse shallow depression, fused laterally to episternum; episternum and epimeron completely separate, apex separated from body; pleural suture (ps) distinct; episternum triangular, elongate, glabrous, apex forms anterolateral border of coxal cavity; epimeron triangular, nearly as long as wide, surface glabrous, posterolateral margin with dense fringe of erect setae; basisternum broad, slightly convex before coxae, fused to episternum laterally, with sharp, raised, longitudinal carina between coxal cavities; coxal cavities broad, deep, bordered anteriorly by basisternum, anterolaterally by episternum, laterally and posteriorly by metabasisternum, medially by raised mesosternal carina, lack dense setation at posterior margin.

Metathorax. (Fig. 3E,F,H). Metanotum (Fig. 3F) composed of acrotergite, prescutum (ps), fused scutum-scutellum (sct-sclt), postnotum (pn); acrotergite narrow, transverse, forming thin, narrow, vertical wall anterior to prescutum, fused to prescutum; prescutum transverse, distinctly separated from scutum medially, anterolaterally connected to anterior notal wing process (anp), posterolaterally connected to scutum; fused scutum-scutellum large; scutellum broadly expanded anterolaterally to partially cover lateral ends of prescutum; transverse scutal suture (tss) separates anterior expansion of scutum from larger, triangular, posterior portion; postero-lateral scutal suture (plss) marks lateral margin between scutum and postnotum, medioposterior margin marked by scutoscutellar suture (sss = vr of Blackwelder, 1936); scutellum triangular, distinctly separated from postnotum; median groove (mg) distinctly bisects scutum and scutellum into right and left halves; postnotum with posterior, medially expanded, transverse portion, and expanded, lateral portions connected anteriorly to anterolateral margin of scutum. Metasternum (Fig. 3E) composed of basisternum (s.III) and episternum (eps), (epimeron not figured); basisternum large, broad, broadly longitudinally depressed between coxae, anterior margin biemarginate, form posterior and lateral margins of mesocoxal cavities, anterior margin flat, not fused to mesosternal carina, lateral margins straight, bordered by episternum, posterior margin biemarginate; coxal cavities widely separated; episternum elongate, triangular, widest at posterior end; metendosternite (Fig. 3H) composed of paired elongate-slender, parallel furcal arms attached at base directly to metasternum, lacking basal stalk, anterior arms, and postero-lateral arms.

Legs. Procoxae moderate in size, conical, contiguous; mesocoxae subequal in size to procoxae, globular, separated by small meso-sternal carina; metacoxae moderate in size, conical, distinctly, but not widely, separated; trochanters small, triangular; metatrochanter barely separates metacoxa from metafemur and bears an angulate flange in the male; femora relatively long, gradually expanded distally; tibiae elongate, slender, parallel-sided; protibia recurved, dense setal patch along distal half; mesotibia and metatibia straight; mesotibia with dense setal patch along distal half; tarsi long, slender; tarsomeres I-IV decreasing in length, tarsomere V elongate; male tarsomeres I-III with dense setal patch ventrally.

Elytra. Elytra entire, elongate, distinctly convex, 4.2-5.3mm long for males (mean = 4.8mm), 4.0-4.6mm long for females (mean = 4.3mm), 2.3-3.0mm wide for males (mean = 2.6mm), 2.3-2.6mm wide for females (mean = 2.5mm); elevated at posterior third, widest just posterior to

middle; base distinctly wider than posterior of pronotum; humeri very distinct; elytral punctation in 3-5 distinct rows on each side of disc; basal fovea lacking. Hindwings fully developed. Setation long, erect, setae at apex slightly curved posteriorly.

Abdominal sternites. Sutures slightly arcuate. Visible sternite 1 twice as long as sternite 2; sternites 2-5 subequal in length; sternite 6 subtriangular, nearly as long as wide. Sternite 6 of males with distinct, broad emargination.

Male genitalia. (Fig. 2F-H). Aedeagus elongate, moderately curved dorsally, slightly narrowed distally, length 5 × width; median lobe tubular, length 3 × width, lightly sclerotised, widest at base, base rounded, slightly narrowed to apex, apex broadly truncate, open; foramen small, located 1/3 distance from base to apex of median lobe, subquadrate; base with sclerotised plate and membranous ring; parameres present, strongly sclerotised, unfused, half again longer than median lobe, each narrowed at apex with broad process pointing laterally.

Female genitalia. (Fig. 2I-K). Ovipositor composed of fused paraprocts (papt), paired valvifers (vlf), coxites (cxt), and unpaired proctiger (ptgr); styli absent; in dorsal view (Fig. 2J), paraprocts large, fused at dorsal midline only for posterior third of length, sharply taper to anterior apex, lateral margins convexly curved; proctiger subtriangular, slightly longer than wide, posterior margin densely fringed with moderate length setae; in lateral view (Fig. 2K), paraproct elongate, widest at distal third, with posterior setose cuticular expansion, narrowed ventroanteriorly; proctiger subtriangular, narrowed dorsally, widened ventrally; valvifer elongate, slender, narrowed anteriorly, unfused, but adjacent to nearly entire ventral margin of paraproct, medial margin finely corrugated; in ventral view (Fig. 2I), valvifers lightly sclerotised, elongate, slightly narrowed anteriorly, widest at base of coxites; coxites elongate, length nearly 4 × width, apex rounded, distal half densely covered with short setae. Spermatheca (sp) weakly sclerotised, oblong, expanded to cover insertion of spermathecal and accessory gland (ag) ducts; spermathecal duct long, slender, length 5-6 × length of spermatheca; accessory gland elongated with transverse apex, well sclerotised, connected to spermatheca by short duct; bursa copulatrix (bc) elongate, straight at basal half, narrowed, coiled at distal half.

LARVA. (Fig. 4A-G). Campodeiform, subparallel; entirely whitish except for reddish brown head, thoracic and abdominal terga; thorax flattened dorsally; abdomen gently narrowing, with 9 abdominal segments visible in dorsal view, urogomphi present, legs long, mandibles conspicuous. Length 8.5-8.6mm. Setation erect, sparse ventrally, dense dorsally; setae rigid, spine-shaped.

Head. (Fig. 4B-C). Prognathous and protracted, strongly depressed, with slightly differentiated neck; moderately sclerotised, testaceous, subtriangular, transverse behind, broadly rounded anteriorly, slightly wider than long; occipital foramen relatively large, without distinct raised margin forming the neck; antennal insertions dorsolateral; frontoclypeal suture absent; labrum fused to head to form nasale; gula and gular suture absent; coronal suture distinct, long; frontal sutures V-shaped, sinuate, well-defined and complete, nearly reaching the antennal insertions; ocelli present, well-defined; one single large, low dome-shaped ocellus on each side lying dorsolaterally well behind antennal insertions; dorsal head setation moderately sparse, erect; chaetetoxy as in Fig. 4B-C. Antennae (Fig. 4D) 3-segmented; antennomere I elongate, slender, length 4-5 × width, without sensilla; II elongate, cylindrical, nearly twice as long as I, two sensory appendages lying anterodorsally, elongate, spatulate; III distinct, elongate, with 3 slender terminal spines. Mandibles (Fig. 4G) typically scydmaenid, clearly divided into a broad, basal area and an apical incisor area, strongly sclerotised, with retinaculum and 1 basal tooth, with few short setae; maxillae (Fig. 4E) without visible articulating area; maxillary palpi with 3 palpomeres; palpomere 1 short, subcylindrical, distinctly articulated with stipes; II elongate, subcylindrical, curved; III elongate, pointed, as long as II; labium (Fig. 4F) without ligula, weakly concave apically; without a row of papilliform sensilla distally, not distinctly subdivided into prementum, mentum and submentum ventrally; labial palpi with 3 palpomeres, separated, articulated; II elongate, cylindrical; III elongate, pointed.

Thorax. Depressed, median suture distinct, terga strongly sclerotised, slightly expanded laterally, transverse; sterna membranous; mesothoracic spiracles situated anterolaterally. Legs with rows of spine-shaped setae; coxae elongate, tibia subequal in length to femora, tarsungulus with two basal setae, but lacking pre-apical barbs.

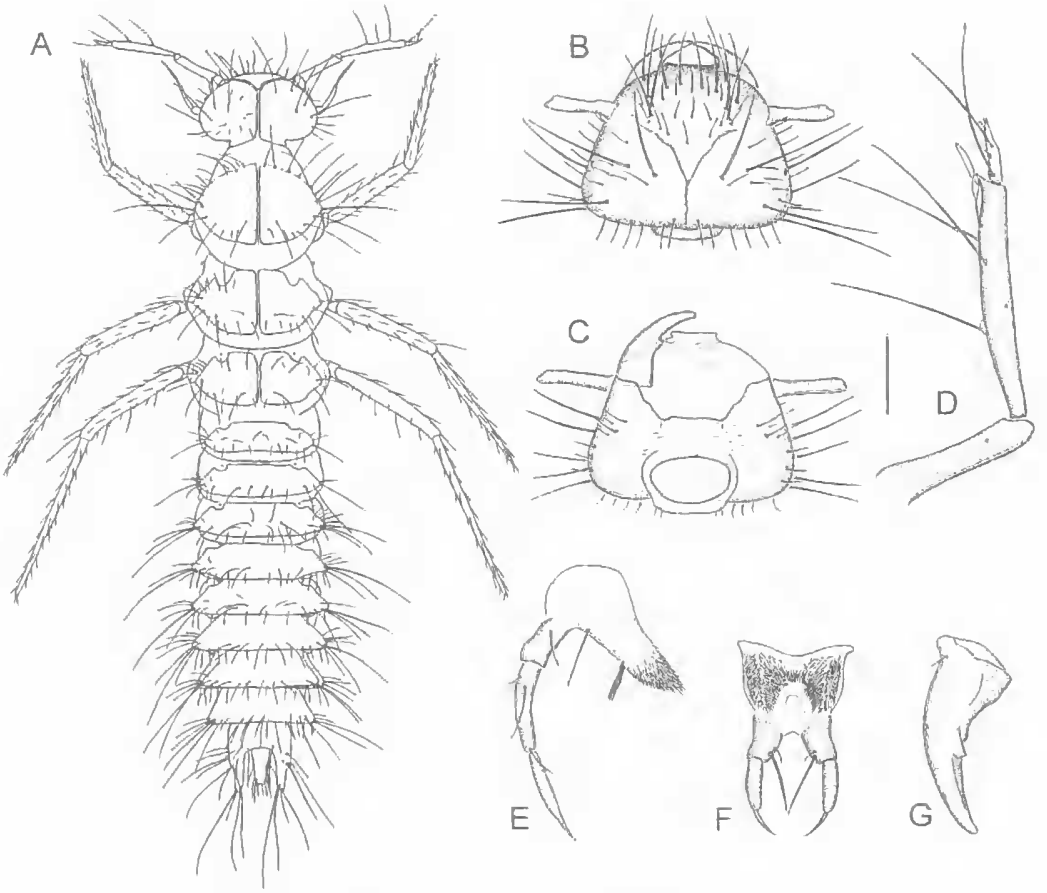

FIG. 4. Larva of *Clidicus abbotensis* O'Keefe. A, habitus, dorsal view; B, head, dorsal view; C, head, ventral view, D, right antenna, dorsal view; E, right maxilla, anterior view; F, labium, dorsal view; G, right mandible, anterior view. Scale bars: A = 1.00mm, B-C = 0.50mm, D-G = 0.25mm.

Abdominal segments. Transverse, of even width, slightly smaller than the thoracic ones, terga strongly sclerotised; setation abundant, stout, lateral setae longer, mostly originating from raised, rounded tubercles; abdominal spiracles lateral, ventroanterior to tubercle, present in segments I-VIII; segment IX transverse, trapezoidal, with a pair of pale, unsclerotised, mostly staphylinoid-like but unarticulated urogomphi, the latter pointed apically and each bearing 5 long apical setae; segment X cylindric, not visible from above because of its position on the ventral side of segment IX, the apex with a corona of short setae.

DISCUSSION

ADULT TAXONOMY. The phylogenetic relationships of *C. abbotensis* to other *Clidicus* species will be discussed when *Clidicus* is revised. Besuchet (1971) provided the most recent key to species, but it was limited to Sri Lankan species. Lhoste (1937b) provided a key to species known then, but did not revise it to incorporate *C. termitophilus* or *C. mysorensis* when he described them in 1939 (Lhoste, 1939). The key below is based on literature descriptions and discussions and is intended as a working key until there is a complete revision. Separation of *C. termitophilus* and *C. laticeps* is not possible based on their descriptions.

KEY TO ADULTS OF *CLIDICUS* LAPORTE

1. Antennomeres V-VIII distinctly longer than wide . . . 2
   Antennomeres V-VIII as wide as long or nearly so . . . 6
2. Dorso-posterior impression on head round; Borneo . . . . . *C. taphrocephalus* Gestro
   Dorso-posterior impression on head triangular. 3
3. Elytral apices acuminate; Sri Lanka . *C. loebli* Besuchet
   Elytral apices rounded 4
4. Propleura with anterior process; Sri Lanka . . . . . *C. monstrosus* (Walker)
   Propleura rounded anteriorly. 5
5. Antennomere I as long as II-IV combined; apices of parameres directed medially (Lhoste 1939: 508, fig. 1); India . . . . . *C. mysorensis* Lhoste
   Antennomere I longer than II-IV combined; apices of parameres directed laterally (Fig. 2F); Australia . . . . . *C. abbotensis* O'Keefe
6. Pronotum distinctly foveate 7
   Pronotum weakly or not foveate 8
7. Borneo . . . . . *C. termitophilus* Lhoste
   Indonesia. . . . . *C. laticeps* Pic
8. Base of pronotum with triangular depression; Sri Lanka. . . . . *C. quadricollis* Besuchet
   Base of pronotum convexly rounded; Sri Lanka, Vietnam, Indonesia 9
9. 4-5mm in length 10
   7-10mm in length 11
10. Parameres shorter than median lobe which is narrowed at apex (Besuchet 1971: 256, fig. 12); Sri Lanka . . . . . *C. mussardi* Besuchet
    Parameres longer than median lobe which is broad at apex (Lhoste 1937a: 281, fig. 4); Vietnam . . . . . *C. tonkinensis* Lhos
11. Pronotum as wide as long; antennae three-fourths body length . . . . . *C. grandis* Laporte
    Pronotum wider than long; antennae subequal to body length . . . . . *C. formicarius* Pascoe

CATALOGUE OF SPECIES OF *CLIDICUS*.

C. abbotensis O'Keefe, new species. AUSTRALIA (Qld)

C. halticus Schaufuss, 1896: 51; Handlirsch, 1906: 735; Larsson, 1978: 110; Spahr, 1981: 90. BALTIC AMBER.

C. formicarius Pascoe, 1863: 28, figs 2-3; Gestro, 1878: 145, 146, figs (unnumbered); Schaufuss, 1884: 394; Reitter, 1887a: 64; Reitter, 1887b: 303; Atkinson, 1891: 186; Wasmann, 1896: 16; Csiki, 1919: 86; Blattný, 1925: 1; Lhoste, 1937b: 278. BORNEO, JAVA, SUMATRA.

v. *doriae* Schaufuss, 1884: 394, 419; Reitter, 1887a: 64; Wasmann, 1896: 16; Csiki, 1919: 87. SUMATRA.

C. grandis Laporte, 1832: 397; Laporte, 1835: 130; Laporte, 1840: 209; Lacordaire, 1854: 109, pl. 16 fig. 4; Fairmaire, 1856: 529; Gestro, 1878: 145, 147, figs (unnumbered); Reitter, 1887b: 304; Atkinson, 1891: 186; Wasmann, 1896: 16; Kempers, 1899: 202, fig. 3; Csiki, 1919: 87; Lhoste, 1936: 250, fig. 1; Lhoste, 1937b: 279, fig. 3. BORNEO, JAVA.

v. *ganglbauri* Reitter, 1887a: 64; Wasmann, 1896: 17; Csiki, 1919: 87 (placed as a variety by Wasmann). JAVA.

C. laticeps Pic, 1928: 7; Lhoste, 1937b: 279. INDONESIA.

C. loebli Besuchet, 1971: 251, 254, figs 1, 6, 10. SRI LANKA.

C. monstrosus (Walker); Atkinson, 1891: 187; Csiki, 1919: 87; Lhoste, 1937b: 278; Besuchet, 1971: 251, figs 4, 8. SRI LANKA.

Erineus monstrosus Walker, 1858: 206.

C. mussardi Besuchet, 1971: 251, 255, figs 2-3, 7, 11-14. SRI LANKA.

C. mysorensis Lhoste, 1939: 508, figs 1-2. INDIA.

C. quadricolis Besuchet, 1971: 251, 252, figs 5, 9. SRI LANKA.

C. taphrocephalus Gestro, 1878: 144, figs (unnumbered); Reitter, 1887b: 303; Atkinson, 1891: 187; Wasmann, 1896: 17; Csiki, 1919: 87; Lhoste, 1937b: 278. BORNEO, SARAWAK.

C. termitophilus Lhoste, 1939: 509, figs 3-5. BORNEO.

C. tonkinensis Lhoste, 1937a: 409; Lhoste, 1937b: 279, 280, figs 1, 4. VIETNAM.

LARVA. Larvae of scydmaenid beetles are still largely unknown, none being described since Vit & De Marzo (1989). Work by Brown & Crowson (1980) is still the best general treatment of scydmaenid larvae, and Newton (1991) provided the most recent review. Detailed descriptions and figures exist only for larvae of *Stenichnus* (Wheeler & Pakaluk, 1983), *Mastigus* (De Marzo, 1983, 1984) and *Leptomastax* (Vit & De Marzo, 1989). Larvae are unknown for other species of *Clidicus*, as well as for any species in the other two genera in the tribe (*Leptochromus* Motschulsky and *Papusus* Casey).

KEY TO GENERA OF SCYDMAENIDAE BASED ON KNOWN LARVAE (modified from Vit & De Marzo, 1989).

1. Abdominal segment IX with a pair of thick urogomphi; body slender, elongate; integument pale. 2
   Abdominal segment IX without urogomphi; body moderately elongate to ovate; integument more or less pigmented . . . . . Cyrtoscydmini, ... Scydmaenini (see Brown & Crowson, 1980)
2. Urogomphi horny, cucujoid-like; abdominal segment X exposed in dorsal view; head with or without distinct frontal sutures and without ocelli; antennal insertions lateral; nasale without projections . . . . . Eutheiini
   Urogomphi unsclerotised, staphylinoid-like; only 9 abdominal segments visible in dorsal view; segment X situated on the ventral side of IX; head with distinct frontal sutures and large single ocellus; antennal insertions dorso-median; nasale projected in two acute lobes 3
3. Mandibles elongate, curved, without subapical teeth; thoracic and abdominal tergites not sclerotised; urogomphi apices rounded . . . *Leptomastax* Pirazzoli
   Mandibles with broad base and narrowed incisor, subapical tooth present; thoracic and abdominal tergites strongly sclerotised; urogomphi apices pointed. . . . . *Clidicus* Laporte

BIOLOGY. Despite the attention *Clidicus* species have received taxonomically, very little is known about their biology. Wasmann (1896: 18) mentioned a note he had received from Fruhstorfer stating that he had found *C. formicarius* associated with the ant, *Leptogenys fruhstorferi* (Emery) in western Java. Lhoste (1939: 510) reported *C. termitophilus* was found in association with unidentified termites. Besuchet (1971: 249) noted that members of *Clidicus* were collected in leaf litter.

Field observations showed *Clidicus abbotensis* is strongly diurnal in activity and its bright orange coloring makes it quite conspicuous in daylight. After several hours headlight searching by four observers, only one specimen was found active at night in the same area where more than 100 were taken in a few hours during the day. Adults in the daytime were almost constantly on the move on the ground, on rocks and on tree bases, but were most frequently found on small and large dead logs, especially where some bark was still loosely attached. Most of those located in wet sclerophyll habitat at the summit shoulder were under loose bark sheets peeling off the base of fire-killed trees of *Allocasuarina torulosa*. To test whether their bright color and exposed activity might indicate chemical defense, a live specimen was chewed thoroughly by GBM but no distastefulness was noticed. Several mating pairs were noted in the daytime, but most of the roaming activity seemed to be involved with foraging for prey. Two adults were found carrying a soft white object in their jaws which was identified as a large, slow-moving collembolan (Neanuridae: Neanurinae: Lobellini: *Hemilobella* sp., probably undescribed; Penelope Greenslade, pers. comm.) of which many were noticed under bark and on dead wood. Seven larvae of *C. abbotensis* were collected, all walking in close proximity to foraging adults and presumably seeking the same prey. In life the larvae were the same bright color as the adults.

Tavares & Balazuc (1989) reported a new genus and species of ascomycete fungus, *Sugiyamaemyces orousettii* Tavares & Balazuc, collected from profemora and mesotibiae of two museum specimens of *C. formicarius*, one from Borneo (Zoological Museum, Berlin) and the other from Sarawak (type specimen of *C. formicarius* in the Natural History Museum, London). The senior author examined 77 specimens of *C. abbotensis* (41 males and 36 females) and found fungal thalli and conidia on 21 males, but none on any female. On all but one specimen the thalli and conidia were found only on abdominal sternites. On the remaining specimen conidia were found on abdominal sternites and on the metabasisternum immediately anterior to the left metacoxa. Dr Tavares identified the fungus as an undescribed species of *Cryptandromyces*.

DISTRIBUTION. Lhoste (1937a: 281-282) discussed the biogeography of *Clidicus* and concluded that the center of origin of *Clidicus* was Java-Sumatra-Borneo. He hypothesised that *Clidicus* had dispersed in two directions — west to Sri Lanka and north to temperate Asia. The previous distribution of *Clidicus* extended from India and Sri Lanka in the west to Indonesia (Borneo, Sumatra and Java) in the east, and Vietnam in the north (Fig. 5A). Another undescribed species occurs in the Philippines (O'Keefe, unpubl. data; specimens in Bishop Museum, Hawaii). The presence of *Clidicus* in Queensland, Australia, represents a disjunction of over 3,500km to the southeast.

It is unlikely that *Clidicus* occurs elsewhere in Australia. Given their rainforest habitat in SE Asia and the presence of this Australian species on a cool, moist mountaintop, it can be assumed that other occurrences would be in similar habitats which occur only along the coastal belt of eastern Australia. However, these mountain habitats have been intensively and systematically surveyed for insects, especially flightless ground Coleoptera, by the Queensland Museum for 20 years. *Clidicus* are conspicuous, diurnal beetles, and would not have been easily overlooked.

The isolated occurrence of *C. abbotensis* on Mt Abbot is quite remarkable, but perhaps is related to the mountain's unique geographic position. It lies as a high, cool refuge in the middle of an arid corridor formed where the 1,000mm annual rainfall isohyet swings across the coast to enclose a 200km belt of arid lowlands (Fig. 5C). This arid belt separates the mountain rainforest of the northern Cairns region (the Wet Tropics) from those of the southern Proserpine/Eungella region (Central Queensland). Darlington (1961a), on the basis of flightless Carabidae, first drew attention to this barrier and Monteith (1997), using aradid bugs, later quantified it as the most powerful barrier along the entire eastern continental margin with only 12% sharing of fauna across it.

Figure 5C shows the relationship of Mt Abbot to these rainforest systems. It is the highest massif in the 250km between Mt Williams (1,259m), an isolated peak in the Eungella systemat the southern end of the Wet Tropics, and Mt Elliot (1,220m) to the north. Another peak of

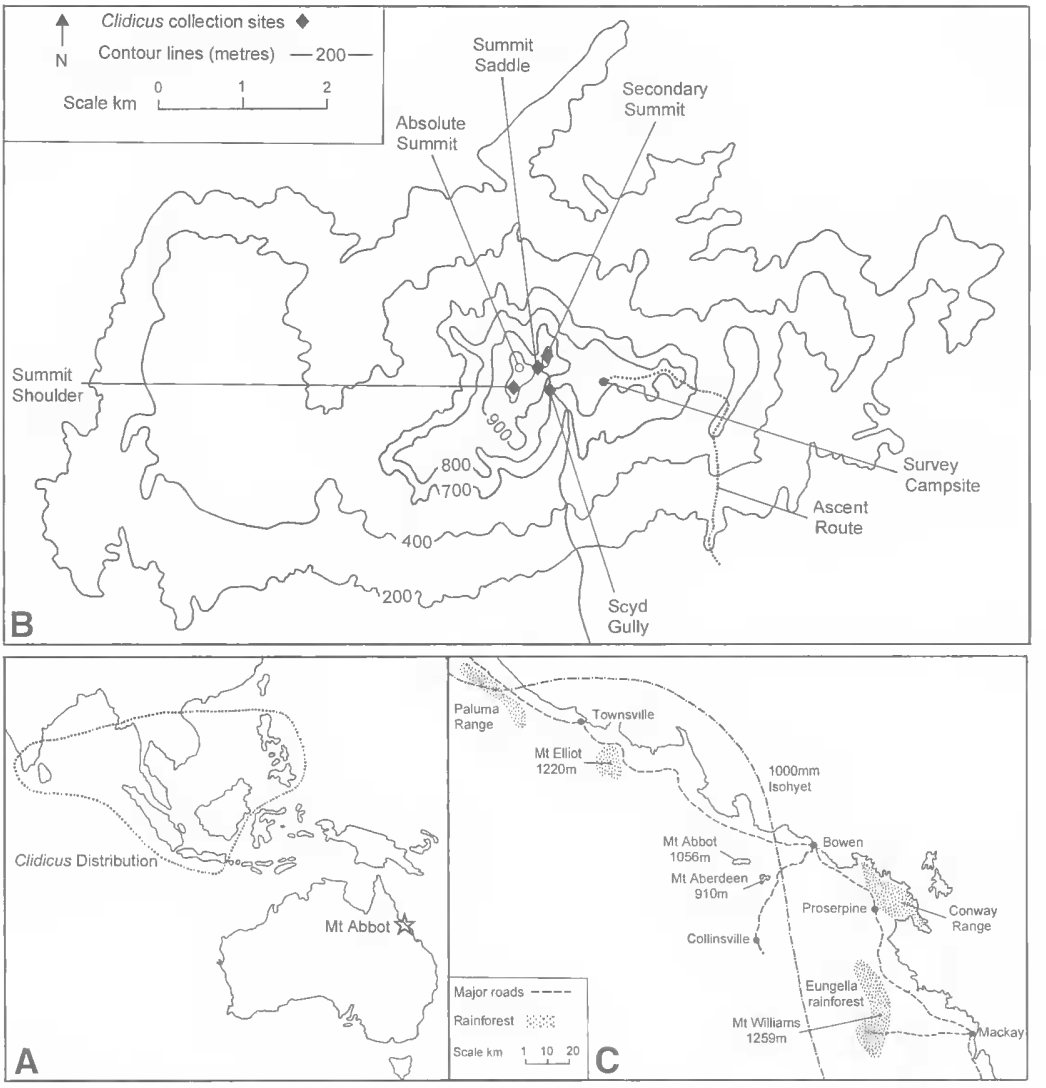

FIG. 5. A, Indo-Australian region showing previous known limits of *Clidicus* distribution and location of Mt Abbot in Australia. B, detailed topography of Mt Abbot, showing sites mentioned in text. C, location of Mt Abbot in Queensland with respect to other mountains, rainforest tracts and the 1,000mm rainfall isohyet.

significance is Mt Aberdeen (910m), about 20km SE of Mt Abbot, which is much smaller but has a small tract of cloud-induced rainforest on its narrow summit. Its insects were also sampled for the first time in 1996/97. Mt Abbot and Mt Aberdeen thus lie in an arid barrier zone where conventional wisdom has it that the flightless rainforest Carabidae which Darlington (1961a) discussed, do not occur. However, several were collected, indicating a most unusual fauna on Mt Abbot. Examples are as follows: *Pamborus* (Carabidae: Cychrini) has a species pair with *P. transitus* Darlington at Eungella and *P. tropicus* Darlington at Paluma in the Wet Tropics (Darlington, 1961b). *Pamborus* does not occur on Elliot or Aberdeen but was common on Abbot where the species is the southern *P. transitus*. *Mystropomus* (Carabidae: Ozaenini) has a species pair with *M. subcostatus* Chaudoir at Eungella and *M. regularis* Banniger at Paluma.

Again, no *Mystropomus* occurs on Elliot or Aberdeen but in this case the northern species, *M. regularis*, was common on Abbot. *Apocryphodes* (Tenebrionidae: Adeliini) is a newly described genus thought restricted to the Wet Tropics zone (Matthews,1998). It was not found at Elliot or Aberdeen but a new species was collected on Abbot. *Canthonosoma* (Scarabaeidae: Scarabaeini) is a genus of flightless dung beetles with three species thought restricted to the south of Rockhampton (Matthews, 1974). Members of the genus were found 300km further north on the summits of both Mt Aberdeen and Mt Abbot. But whereas the Aberdeen species was the common Rockhampton species, *C. macleayi* Harold, the population on top of Abbott, only 20km distant, is a striking new endemic species with prominent elytral costae.

This highly disharmonic fauna on the summit of Mt Abbot, with elements from both sides of a major biogeographic barrier preserved side by side, indicates an ancient refugial capacity which has absorbed these elements from periods in the distant past when climatic and physiographic fluctuations perturbed the barriers which are in place today. The presence of *Clidicus* there indicates that these factors have perhaps acted at an even greater distance scale in the past than applies to the examples above.

ACKNOWLEDGEMENTS

We thank Geoff Thompson for preparing Figures 1, 2A, 4A and 5, Eric Conti for assistance with translations from French and Italian, Isabelle Tavares for identification of the fungus, Don Chandler, Jerry Cook and Alfred Newton for comments improving this paper, and Doug Cook, Chris Burwell and Heather Janetzki for assistance in collection of specimens.

LITERATURE CITED

ATKINSON, E. 1891 (1890). Catalog of the Insecta of the Oriental Region. Order Coleoptera family Scydmaenidae. Journal of the Asiatic Society of Bengal 59 (suppl. 2): 177-187.

BEAN, A.R. 1994. An analysis of the vascular flora of Mt Abbot near Bowen, Queensland. Proceedings of the Royal Society of Queensland 104: 43-66.

BESUCHET, C. 1971. Les *Clidicus* de Ceylon (Col. Scydmaenidae). Mitteilungen der Schweizerischen Entomologischen Gesellschaft 43: 249-257.

BLACKWELDER, R.E. 1936. Morphology of the colcopterous family Staphylinidae. Smithsonian Miscellaneous Collections 94: 1-102.

BLATTNÝ, C. 1925. Fauna Sumatrensis (Beitrag Nr. 24). Scydmaenidae (Col.). Supplementa Entomologica 14: 1-13.

BROWN, C. & CROWSON, R.A. 1980 (1979). Observations on scydmaenid (Col.) larvae with a tentative key to the main British genera. Entomologists' Monthly Magazine 115: 49-59.

CSIKI, E. 1919. Scydmaenidae, Pars 70. Pp. 1-106. In Schenkling, S. (ed.) Coleopterorum Catalogus, Vol. 12. (W. Junk: Berlin).

DARLINGTON, P.J. Jr 1961a. Australian carabid beetles. V. Transition of wet forest faunas from New Guinea to Tasmania. Psyche 68: 1-24.

1961b. Australian carabid beetles. VI. The tropical and some subtropical species of *Pamborus, Mystropomus and Nurus*. Breviora 142: 1-13.

DE MARZO, L. 1983. Osservazioni sulla ovideposizione e sul ciclo larvale in *Mastigus pilifer* Kraatz (Coleoptera, Scydmaenidae). Entomologica (Bari) 18: 125-136.

1984. Morfologia delle larve e pupa in *Mastigus pilifer* Kraatz (Coleoptera, Scydmaenidae). Entomologica (Bari) 19: 61-74.

FAIRMAIRE, L. 1856. Miscellanea entomologica. Première partie. Annales de la Société Entomologique de France (Series 3) 4: 516-548.

GESTRO, R. 1878. Appunti Entomologica. Annali del Museo Civoco di Storia Naturale di Genova 12: 144-149.

HANDLIRSCH, A. 1906. Die fossilen Insekten und die Phylogenie der rezenten Formen. IX + V + 1430 pp. (Englemann: Leipzig).

KEMPERS, K.J.W. 1899. Het adersysteem der kevervleugels. Tijdschrift voor Entomologie 42: 180-208.

LACORDAIRE, J.T. 1854. Histoire naturelle des Insectes; Genera des Coléoptères. Cicindétès – Palpicornes. Vol. 2. (Librarie Encyclopédique de Roret: Paris).

LAPORTE, F.L. 1832. Mémoire sur cinquante espèces nouvelles ou peu connues d'insectes. Annales de la Société Entomologique de France 1: 386-415.

1835. Études Entomologiques, ou description d'insectes nouveaux, et observations sur la synonymie. Premiere Partie. (Méquignon-Marvis Père et Fils: Paris).

1840. Histoire Naturelle des Insectes, Coléoptères. Volume 1. (P. Dumenil: Paris).

LARSSON, S.G. 1978. Baltic amber: a palaeobiological study. Entomonograph 1: 192.

LHOSTE, J. 1936. L'organ copulateur mâle dans la famille des Scydmaenidae (Colcopt.). Pp. 249-251. In Livre Jubilaire de M. Eugène-Louis Bouvier. (Firmin-Didot: Paris).

1937a. Note sur les genres *Clidicus* Cast. et. *Mastigus* Latr. (Col. Scydmaenidae). Bulletin de la Société Entomologique de France 42: 278-283.

1937b. Sur quelques Scydmaenidae nouveaux d'Asie. Sinensia 8: 399-411.

1939. Notes sur quelques Scydmaenidae. Annals and Magazine of Natural History, London (Series 11) 3: 507-516.

MATTHEWS, E.G. 1974. A revision of the scarabaeine dung beetles of Australia. II. Tribe Scarabaeini.

Australian Journal of Zoology Supplementary Series 24: 1-211.

1998. Classification, phylogeny and biogeography of the genera of Adeliini (Coleoptera: Tenebrionidae). Invertebrate Taxonomy 12: 685-824.

MONTEITH, G.B. 1985. Altitudinal studies at Cape Tribulation, north east Queensland I. Introduction and summary. Queensland Naturalist 26: 40-48.

1997. Revision of the Australian flat bugs of the subfamily Mezirinae (Insecta: Hemiptera: Aradidae). Memoirs of the Queensland Museum 41: 1-169.

NEWTON, A.F. Jr 1991. Scydmaenidae (Staphylinoidea). Pp. 330-334. In Stehr, F.W. (ed.) An introduction to immature insects of North America. Vol. 2. (Kendall/Hunt Publishing Co.: Dubuque, Iowa).

PAINE, A.G.L. & CAMERON, R.L. 1972. Bowen 1: 25,000 Geological Series. (Australian Government Publishing Services: Canberra).

PASCOE, F.P. 1863. Notices of new of little-known genera and species of Coleoptera, Part IV. Journal of Entomology 2: 26-56.

PIC, M. 1928. Coléoptères exotiques en partie nouveaux. L'Echange, Revue Linnéenne 44: 4, 7-8, 10-11, 16.

REITTER, E. 1887a. Uebersicht der bekannten Arten der Coleopteren-Gattung *Clidicus* Casteln. Wiener Entomologische Zeitung 6: 64.

1887b. Coleopterologische Notizen. XXVII. Wiener Entomologische Zeitung 6: 303-306.

SCHAUFUSS, C. 1896. Preussens Bernsteinkäfer. II. Neue Formen aus der Helm'schen Sammlung im Danziger Provinzialmuseum. Berliner Entomologische Zeitschrift 1896: 51-54.

SCHAUFUSS, L.W. 1884. Die Scydmaeniden nord-ost-Africa's, der Sunda-Inseln und Neu-Guinea's im Museo Civico di Storia Naturale zu Genua. Annali del Museo Civico di Storia Naturale di Genova 21: 387-424.

SPAHR, U. 1981. Systematischer Katalog der Bernstein- und Kopal-Käfer (Coleoptera). Stuttgarter Beiträge zur Naturkunde Serie B (Geologie und Paläontologie) 80: 1-107.

TAVARES, I. & BALAZUC, J. 1989. *Sugiyamaemyces*, a new genus of Laboulbeniales (Ascomycetes) on *Clidicus* (Scydmaenidae). Mycotaxon 34: 565-576.

VIT, S. & DE MARZO, L. 1989. Description of the larva of *Leptomastax hypogeus* Pirazzoli (Coleoptera Scydmaenidae). Archives des Sciences [Genéve] 42: 569-578.

WALKER, F. 1858. Characters of some apparently undescribed Ceylon Insects. Annals and Magazine of Natural History (series 3) 2: 202-209, 280-286.

WASMANN, E. 1896. Note III. A revision of the genus *Clidicus*. Notes from the Leyden Museum 18: 14-18.

WHEELER, Q.D. & PAKALUK, J. 1983. Descriptions of larval *Stenichnus (Cyrtoscydmus)*: *S. turbatus* and *S. conjux*, with notes on their natural history (Coleoptera: Scydmaenidae). Proceedings of the Entomological Society of Washington 85: 86-97.